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(54) **Mobile terminal and method of providing a network-to-network connection**

Mobiles Endgerät und Verfahren zur Netz-zu-Netz-Verbindung

Terminal mobile et procédé pour assurer une connexion de réseau à réseau

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**WO-A-00/18066** **WO-A-01/86908**
**WO-A-99/16266**

- **PERKINS C E ET AL: "USING DHCP WITH COMPUTERS THAT MOVE" , WIRELESS NETWORKS, ACM, US, VOL. 1, NR. 3, PAGE(S) 341-353 XP000538245 ISSN: 1022-0038 abstract page 341, left-hand column, line 1 -page 344, left-hand column, line 25**



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## Description

### BACKGROUND OF THE INVENTION

Technical Field of the Invention

**[0001]** This invention relates to telecommunication systems and, more particularly, to a mobile terminal and a method of connecting a computer network to a packet data network (PDN) over a single wireless link.

Description of Related Art

**[0002]** In the General Packet Radio Service (GPRS) network architecture, the "Mobile Terminal" (MT) is the radio device handling the GPRS air interface. The "Terminal Equipment" (TE) is the user equipment connected to the MT, and the "Mobile Station" (MS) designates both TE and MT together. In the Universal Mobile Telephony System (UMTS) architecture, the term "User Equipment" (UE) is equivalent to the GPRS MS.

**[0003]** In GPRS, the use of the Point-to-Point Protocol (PPP) to connect a single TE such as a laptop computer to an MT for the provision of wireless packet and Internet access has been well-documented in the UMTS standards UMTS 23.060 and UMTS 27.060. The PPP protocol uses two protocols, the Link Control Protocol (LCP) and the Network Control Protocol (NCP) to first establish the link between the TE and the MT, and then to provide a dynamic IP address to the TE. The way the technology and the standards are defined, however, they enable only one IP device to be connected through one cellular link.

**[0004]** In the current cellular packet data network technologies, such as GPRS/GSM (Global System for Mobile Communications), GPRS/EDGE (Enhanced Data Rates for GPRS Evolution), and UMTS, the network side can only associate a single host with each radio link between the Base Station System (BSS) and an MT. If more than one host is connected to the MT, the network is not able to handle this with only one packet data address association.

**[0005]** In the future, a user may carry a plurality of devices (for example, a Personal Digital Assistant (PDA), a laptop computer, a mobile telephone, etc.) that are capable of communicating with each other over a wired or wireless network. These devices may be connected to each other over a small Local Area Network (LAN) or a wireless LAN utilizing technologies such as Bluetooth, for example. It would be desirable to provide two-way connectivity to PDNs such as the Internet for all of the devices connected to the user's LAN.

**[0006]** GPRS allows the MT to open up several Packet Data Protocol (PDP) Contexts at the same time. In the GPRS architecture, the MT is connected to one or more TEs through the defined "R" interface. However, each opened PDP Context requires a separate PPP stack in the MT in a one-to-one ratio, since PPP requires two unique endpoints for each opened session. Thus, a subscriber with a PDA and a laptop essentially requires two cellular links (and possibly two cellular subscriptions) to simultaneously connect both of the devices to the Internet.

**[0007]** With the advent of ad hoc networking, and with the important increase in bandwidth of the cellular PDNs based on EDGE and UMTS, it is expected that the capability to connect a network of computers through a single cellular link will become more critical. This is not possible today because the network assigns only one packet data address to the MS, and it is impossible for the PDN to associate with a TE if the TE does not have a unique address. When multiple TEs try to connect to the network through the use of only one MT, there is an insufficient number of address associations. The existing cellular packet data technologies allow associating many packet data addresses with the same host, but that is of no help in solving the problem here. No direct method based on ISO layer 2 and 3 technology can be used to solve this problem. In addition, there are no existing cellular protocols or IP protocols that can be used to solve the problem.

**[0008]** One partial solution is provided in the International Patent Application WO/18066 to Bender et al., herein called Bender, that teaches a system providing a wireless data service, wherein the system includes a wireless modem connected to one or more terminal equipment over a local area network using Ethernet. A network remote server provides IP address information in response to terminal equipment request messages to the terminal equipment units. In addition, a local server is also coupled to the wireless modem and may provide IP address information in response to request messages from terminal equipment units. In Fig. 3 B and in its associated description, Bender teaches that according to his invention, the point-to-point protocol is only utilized for communication over the wireless interface 56 that extends between the wireless modem and the network unit. Therefore, Bender fails to teach or suggest the utilization of separate PPP sessions between the terminal equipment(s) and the wireless modem. Bender states that the PPP layers are not adapted to provide the terminal equipment with separate IP addresses.

**[0009]** In order to overcome the disadvantage of existing solutions, it would be advantageous to have a mobile terminal and a method of connecting a plurality of devices with a plurality of IP addresses through the mobile terminal and a single wireless link, by establishing different PPP sessions between the terminal equipment ond the mobile terminal, to a packet data network (PDN) such as the Internet. The present invention provides such a mobile terminal and method.

### SUMMARY OF THE INVENTION

**[0010]** The invention is defined by the method and the mobile terminal of independent claims 1 and 5. In the present invention, the MT requests a separate PDP Context for each device on the LAN, and utilizes a PPP over

Ethernet (PPPoE) session between the devices on the LAN and the MT to virtually separate the physical network connection into a plurality of unique individual IP addresses assignable to the plurality of devices on the LAN,

**[0011]** In an embodiment of the MT, the MT includes (1) means for requesting from the PDN, a separate packet data protocol (PDP) Context for each device on the LAN; and (2) a Point-to-Point Protocol over Ethernet (PPPoE) stack. The PPPoE stack connects the MT to the plurality of devices on the LAN, receives an indication from each individual device on the LAN whether the device requires an IP address, and distributes IP addresses to the plurality of devices on the LAN,

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0012]** The invention will be better understood and its numerous objects and advantages will become more apparent to those skilled in the art by reference to the following drawings, in conjunction with the accompanying specification, in which:

FIG. 1 is a simplified block diagram of a network architecture suitable for implementing the method of the present invention;

FIG. 2 is a simplified functional block diagram of a mobile terminal in which a Dynamic Host Configuration Protocol (DHCP) server is utilized to interface a plurality of TEs with a packet data network;

FIG. 3 is a flow chart illustrating a method to interface the plurality of TEs in FIG. 2;

FIG. 4 is a simplified functional block diagram of an embodiment of a mobile terminal according to the invention in which PPP over Ethernet (PPPoE) is utilized to interface a plurality of TEs with a packet data network; and

FIG. 5 is a flow chart illustrating the steps of the embodiment of the method of the present invention.

## DETAILED DESCRIPTION OF EMBODIMENTS

**[0013]** The following description relates to a method of connecting a plurality of devices with a plurality of IP addresses through a single mobile terminal (MT) and a single wireless link to a packet data network (PDN) such as the Internet. The method includes all the required procedures to connect several hosts or devices in the LAN environment to a single GPRS/UMTS MT, with each host or device having its own IP address. Each of these hosts or devices may then use this single MT to send and receive data to/from the Internet or private PDNs. Two embodiments are identified and described below. Both embodiments are designed for use with a wireless link, and do not add significant overhead to messages sent over the air interface.

**[0014]** FIG. 1 is a simplified block diagram of a network architecture suitable for implementing the method. The exemplary architecture illustrated in FIG. 1 is for a GPRS network, although, in the first embodiment, the method may be utilized with any type of wireless PDN. In the GPRS network architecture, a Mobile Station (MS) 11 includes a Mobile Terminal (MT) 12 which handles the GPRS air interface 13, and a plurality of Terminal Equipment (TEs) 14 which are connected through a wired or wireless LAN 15 to the MT. On the PDN side of the air interface is a Base Station Controller (BSC) 16, a Serving GPRS Support Node (SGSN) 17, the GPRS PDN 18, and a Gateway GPRS Support Node (GGSN) 19 which may be used to connect to other networks.

**[0015]** In order to connect several TEs in the LAN environment to a single GPRS/UMTS MT, with each TE device having its own IP address, the MT 12 implements the normal GPRS/UMTS protocols for connection to the PDN 18, and uses any layer 2 LAN interface (for example Ethernet, 802,11) for connection to the LAN 15. In one embodiment, the MT provides a Dynamic Host Configuration Protocol (DHCP) server on the LAN interface to provide dynamic host configuration for all the TE hosts and devices connected to this interface. The MT on this interface also acts as a router or default gateway for hosts and devices visiting the network. The MT implements a mapping between the DHCP requests from the hosts connected to the LAN and the GPRS/UMTS protocols, and also routes traffic to/from those hosts. In an alternative embodiment, the MT uses PPP over Ethernet (PPPoE, rfc 2516) to connect to each TE with a physical LAN, while maintaining separate logical connections with each individual TE. The subsequent paragraphs describe both the DHCP embodiment and the PPPoE embodiment.

### Embodiment 1: DHCP

**[0016]** FIG. 2 is a simplified functional block diagram of a first embodiment of a mobile terminal 12 in which a DHCP server is utilized to interface a plurality of TEs with a PDN. The MT includes a radio side protocol stack 21 comprising a Radio Link Control/Medium Access Control (RLC/MAC) protocol layer 22, a Logical Link Control (LLC) layer 23, and a Sub-Network Dependence Convergence Protocol (SNDCP) layer 24. Mobility Management/Service Management (MM/SM) is also performed at this layer. On top of the SNDCP layer is an IP stack 25 to which a network address comprising a plurality of individual IP addresses is passed from the PDN 18. The IP stack is linked to a PPP stack 26 which establishes a link between the TEs 14 and the MT 12. A DHCP server 27 is implemented to assign the multiple IP addresses included in the network address to the TE hosts and devices connected to the LAN 15. The PPP stack then provides the dynamic IP addresses to the TEs using 802.x.

**[0017]** FIG. 3 is a flow chart illustrating the steps of the first embodiment. The DHCP embodiment assumes that a user who desires to connect a plurality of devices to a PDN through a single wireless link has some kind of subscription or agreement with the network operator which designates the number of unique individual IP addresses

that the user needs. This is indicated at step 31, At 32, the number of unique individual IP addresses for each subscriber is then stored in a subscriber database in the PDN. At 33, the TEs and the MT are then connected on a network such as a wired or wireless LAN. When the user connects to the IP network, instead of the network assigning a single IP address for a single device to the user device, the network performs a single PDP Context activation procedure at 34, but allocates a network address comprising the number of unique individual IP addresses designated in the subscription agreement. The network address is essentially a collection of single host addresses, and enables a number of devices to be addressed individually. When the IP protocol is used, this means assigning an address such as 10.1.1.0 with a subnet mask of 255.255.255.0 instead of an address such as 10.1.1.1 with a subnet mask of 255.255.255.255. When using the IP protocol, the network address may comprise 1, 2, 4, or 16, etc. single host addresses. The MT then takes the network address and divides it into a plurality of single addresses and distributes it to the separate devices on the LAN or wireless LAN.

**[0018]** Preferably, public IP addresses are provided rather than private IP addresses so that each device can be addressed from PDNs such as the Internet. If private IP addresses are supplied within the LAN, no help is required from the PDN. However, it is anticipated that it will become increasingly important, especially for multimedia types of applications, to be reachable from the PDN. It should be noted that while there is presently a concern regarding the availability of a sufficient number of IP addresses, many more IP addresses will be available when IPv6 is implemented.

**[0019]** Additional procedures may also be implemented to ensure that only the number of IP addresses actually needed are sent to the user's device. After the user accesses the IP network at 34, signaling with the network operator may be utilized to determine at step 35 whether the user needs fewer IP addresses or whether the user needs all of the IP addresses designated in the subscription agreement. If the user requests fewer IP addresses, the process moves to step 36 where the PDN allocates a network IP address to the MT comprising the requested number of individual IP addresses. If the user does not request fewer IP addresses, the process moves to step 37 where the PDN allocates a network IP address to the MT comprising the number of individual IP addresses designated in the subscription agreement. In GPRS or UMTS, this can be accomplished during the PDP Context procedure. The network IP address is assigned to a single PDP Context in the MT 12, and all traffic to/from the GPRS PDN core network 18 is treated as traffic to/from the MT (from the perspectives of authentication, authorization, access control, routing, and charging data).

**[0020]** At step 38, the MT provides the networkIP address and the subnet mask to the DHCP server 27. At 39, the DHCP server assigns the unique individual IP addresses to each of the TEs connected to the LAN. Handling the uplink traffic in the MT is straight forward. For the downlink traffic, the MT receives the IP packets which include the proper final destination address for a particular TE on the LAN. On the LAN interface, the MT then uses normal Address Resolution Protocol (ARP) procedures at step 40 to deliver datagrams to the particular TE.

**[0021]** This solution requires minor changes to the existing GPRS/UMTS protocols in order to enable the PDN to return a network address, However, the solution can scale to a large numberofhosts and devices, is simple for the PDN to implement, does not cost anything more from the PDN perspective, does not complicate routing, and, importantly, does not add overhead to the cellular link. It is then up to the user device to locally distribute the single IP addresses. Each device then has bi-directional IP connectivity.

Embodiment 2: PPPoE

**[0022]** FIG. 4 is a simplified functional block diagram of a second embodiment of a mobile terminal 12 in which PPP over Ethernet (PPPoE) is utilized to interface a plurality of TEs with a PDN. As described above, the MT includes the radio side protocol stack 21 comprising the RLC/MAC protocol layer 22, the LLC layer 23, and the SNDCP layer 24. On top of the SNDCP layer, a plurality of PDP Contexts 45 and 46 are established: one for each TE 14 connected to the LAN 15. The PDP Contexts connect to the PPP stack 26 which establishes a link between the TE 14 and the MT 12 using 802,x,

**[0023]** FIG. 5 is a flow chart illustrating the steps of this embodiment of the method of the present invention. Once again, at step 51, the TEs and the MT are connected on a network such as a wired or wireless LAN. At 52, each TE workstation on the LAN launches a PPP over Ethernet (PPPoE) session with the MT 12 as per rfc 2516. The session ID parameter defined in rfc 2516 is used as an identifier for each PPP host TE. At 53, the Link Control Protocol (LCP) and Network Control Protocol (NCP) phases of the PPP state machine are passed over PPPoE frames between the TEs and the MT. When the MT receives an NCP message from one of the TEs on the LAN at 54, the MT launches a PDP Context for that TE. Thus, for each TE device in the LAN 15 that requires an IP address, the MT uses the existing PDP Context facility, as currently defined in GPRS/UMTS, to request a separate PDP Context procedure from the PDN. At 55, separate links are then set up from each opened PDP Context to the PPP stack. At 56, the IP addresses are sent over the LAN to the TEs using the PPPoE protocol.

**[0024]** In GPRS, the PDP Context is intended to create a number of virtual links, all ending in the same terminal. The GPRS standard allows for up to 14 PDP Contexts to be opened at one time for use by the same device. There is a one-to-one relationship between thePDP Contexts and the TEs connected to the LAN. Therefore, the number of devices in the LAN is limited to 14.

**[0025]** Opening multiple PDP Contexts is a viable so-

lution for connecting multiple TEs through the MT as long as there is only one physical link between the TEs and the MT, since it would be unrealistic to establish a separate link connection to each of the connected TBs. As shown at 57, on the LAN side there is still one physical link, but it is virtually separated into different IP addresses.

**[0026]** In this embodiment, the MT performs the key tasks of the method without requiring a lot of support from the PDN. This solution "costs" more on the PDN side since multiple PDP Contexts must be set up and maintained. However, the function of distributing the IP addresses to the different devices is performed by the MT, and there are no network standardization changes required.

**[0027]** It is thus believed that the operation and construction of the present invention will be apparent from the foregoing description. While the mobile terminal and method shown and described has been characterized as being preferred, it will be readily apparent that various changes and modifications could be made therein without departing from the scope of the invention as defined in the following claims.

## Claims

1. A method of connecting a plurality of devices, each having a unique Internet Protocol, IP, address, through a single Mobile Terminal, hereinafter referred to as MT, and a single wireless connection to a Packet Data Network, hereinafter referred to as PDN, said method comprising the steps of:

   connecting the plurality of devices and the MT on a network; **characterized by**:

   launching a different Point-to-Point Protocol over Ethernet, hereinafter referred to as PPPoE session between each device of the plurality of devices and the MT;
   upon the launching of each one of the different PPPoE sessions, requesting by the MT from the PDN a separate PDP context for each device;
   responsive to the request by the MT, establishing in the MT a separate PDP context for each device from the plurality of devices; and
   linking each one of the PDP contexts established in the MT to a Point-to-Point Protocol, hereinafter referred to as PPP stack of the MT, wherein the PPP stack handles the different PPPoE sessions.

2. The method of connecting a plurality of devices through the single MT and the single wireless connection to the PDN of claim 1, wherein the step of connecting the plurality of devices and the MT on a network includes connecting the plurality of devices and the MT on a Local Area Network, hereinafter referred to as LAN.

3. The method of connecting a plurality of devices through the single MT and the single wireless connection to the PDN of claim 2, wherein the step of connecting the plurality of devices and the MT on the LAN includes connecting the plurality of devices and the MT on a wireless LAN.

4. The method of connecting the plurality of devices through the single MT and the single wireless link to the PDN of claim 1, further comprising the step of sending by the MT, a unique individual IP address to each device on the network over a corresponding PPPoE session.

5. A mobile terminal (MT) for connecting, on a local area network, LAN, a plurality of devices, each having a unique Internet Protocol, hereinafter referred to as IP address, through a single wireless link to a packet data network PDN, said MT **characterized by** comprising:

   a Point-to-Point Protocol PPP stack for connecting the MT to the plurality of devices using a different Point-to-Point Protocol over Ethernet PPPoE session for each one of said devices; and
   a plurality of separate IP PDP contexts, each PDP context being related to one device from the plurality of devices, wherein each PDP context comprises a unique individual IP address for one of the devices.

6. The mobile terminal of claim 5, wherein the MT comprises means for requesting the separate PDP contexts from the PDN and wherein the Point-to-Point Protocol stack comprises:

   means for connecting the MT to the plurality of devices on the LAN;
   means for receiving an indication from each individual device on the LAN whether the device requires an IP address; and
   means for distributing IP addresses to the plurality of devices on the LAN.

## Patentansprüche

1. Verfahren zum Verbinden einer Vielzahl von Vorrichtungen, jede mit einer eindeutigen Internetprotokoll-, IP, -Adresse, durch ein einziges mobiles Endgerät, im folgenden als MT (mobile terminal) bezeichnet, und eine einzige drahtlose Verbindung mit einem Pa-

ketdatennetz (packet data network), im folgenden als PDN bezeichnet, wobei das Verfahren die Schritte umfasst:

Verbinden der Vielzahl von Vorrichtungen und des MT auf einem Netz; **gekennzeichnet durch**:

Starten einer unterschiedlichen Punkt-zu-Punkt- Protokoll- über- Ethernet-(Point- to-Point Protocol over Ethernet), im folgenden als PPPoE bezeichnet, - Sitzung zwischen jeder Vorrichtung der Vielzahl von Vorrichtungen und dem MT;
nach dem Starten jeder einzelnen der unterschiedlichen PPPoE-Sitzungen, Anfordern eines gesonderten PDP-Kontextes für jede Vorrichtung durch das MT vom PDN;
als Antwort auf die Anforderung **durch** das MT, Herstellen eines gesonderten PDP-Kontextes für jede Vorrichtung aus der Vielzahl von Vorrichtungen im MT; und
Verknüpfen jedes einzelnen der im MT hergestellten PDP-Kontexte mit einem Punkt-zu-Punkt-Protokoll-, im folgenden als PPP bezeichnet, -Stapel des MT, wobei der PPP-Stapel die unterschiedlichen PPPoE-Sitzungen handhabt.

**2.** Verfahren zum Verbinden einer Vielzahl von Vorrichtungen durch das einzige MT und die einzige drahtlose Verbindung mit dem PDN nach Anspruch 1, wobei der Schritt des Verbindens der Vielzahl von Vorrichtungen und des MT auf einem Netz das Verbinden der Vielzahl von Vorrichtungen und des MT auf einem lokalen Netz (Local Area Network), im folgenden als LAN bezeichnet, umfasst.

**3.** Verfahren zum Verbinden einer Vielzahl von Vorrichtungen durch das einzige MT und die einzige drahtlose Verbindung mit dem PDN nach Anspruch 2, wobei der Schritt des Verbindens der Vielzahl von Vorrichtungen und des MT auf dem LAN das Verbinden der Vielzahl von Vorrichtungen und des MT auf einem drahtlosen LAN umfasst.

**4.** Verfahren zum Verbinden einer Vielzahl von Vorrichtungen durch das einzige MT und die einzige drahtlose Verbindung mit dem PDN nach Anspruch 1, weiterhin umfassend den Schritt des Sendens durch das MT einer eindeutigen individuellen IP-Adresse an jede Vorrichtung auf dem Netz über eine entsprechende PPPoE-Sitzung.

**5.** Mobiles Endgerät (MT) zum Verbinden einer Vielzahl von Vorrichtungen auf einem lokalen Netz (Local Area Network), LAN, die jeweils eine eindeutige Internetprotokoll-, im folgenden als IP bezeichnet, -Adresse haben, durch eine einzige drahtlose Verbindung mit einem Paketdatennetz, PDN, wobei das MT **dadurch gekennzeichnet ist, dass** es umfasst:

einen Punkt-zu-Punkt-Protokoll-, im folgenden als PPP bezeichnet, - Stapel zum Verbinden des MT mit der Vielzahl von Vorrichtungen mittels Verwendung einer unterschiedlichen Punkt-zu-Punkt- Protokoll- über- Ethernet-(Point- to- Point Protocol over Ethernet) -Sitzung, im folgenden als PPPoE bezeichnet, für jede einzelne der Vorrichtungen; und
eine Vielzahl von gesonderten IP-PDP-Kontexten, wobei jeder PDP-Kontext auf eine Vorrichtung aus der Vielzahl von Vorrichtungen bezogen ist, wobei jeder PDP-Kontext eine eindeutige individuelle IP-Adresse für eine der Vorrichtungen umfasst.

**6.** Mobiles Endgerät nach Anspruch 5, wobei das MT Mittel zum Anfordern des gesonderten PDP Kontextes von dem PDN umfasst, und wobei der Punkt-zu-Punkt-Protokoll-Stapel umfasst:

Mittel zum Verbinden des MT mit der Vielzahl von Vorrichtungen auf dem LAN; Mittel zum Empfangen eines Hinweises von jeder einzelnen individuellen Vorrichtung auf dem LAN, ob die Vorrichtung eine IP-Adresse benötigt; und
Mittel zum Verteilen von IP-Adressen an die Vielzahl von Vorrichtungen auf dem LAN.

**Revendications**

**1.** Une méthode pour connecter une pluralité d'appareils, ayant chacun une adresse IP unique, à travers un terminal mobile unique, ci-après appelé MT, et une connexion sans fil unique à un réseau de données par paquets, ci-après appelé PDN, ladite méthode comprenant les étapes de :

- connecter la pluralité d'appareils et le MT sur un réseau ;
- lancer une session protocole point à point Ethernet, ci-après appelée session PPPoE, différente entre chaque appareil de la pluralité d'appareils et le MT;
- au lancement de chacune des sessions PPPoE différentes, demander par le MT du PDN un contexte PDP distinct pour chaque appareil;
- en réponse a la requête par le MT, établir dans le MT un contexte PDP distinct pour chaque appareil de la pluralité d'appareils; et
- lier chacun des contextes PDP établi dans le MT à une pile protocole point à point du MT, ci-après appelée pile PPP, où la pile PPP gère les sessions PPPoE différentes.

**2.** La méthode pour connecter une pluralité d'appareils à travers le MT unique et la connexion sans fil unique au PDN selon la revendication 1, dans laquelle l'étape de connecter la pluralité d'appareils et le MT sur un réseau comprend l'étape de connecter la pluralité d'appareils et le MT sur un réseau local, ci-après appelé LAN.

**3.** La méthode pour connecter une pluralité d'appareils à travers le MT unique et la connexion sans fil unique au PDN selon la revendication 2, dans laquelle l'étape de connecter la pluralité d'appareils et le MT sur le LAN comprend l'étape de connecter la pluralité d'appareils et le MT sur un LAN sans fil.

**4.** La méthode pour connecter une pluralité d'appareils à travers le MT unique et la connexion sans fil unique au PDN selon la revendication 1, comprenant en outre l'étape d'envoyer par le MT, une adresse IP individuelle unique à chaque appareil sur le réseau par une session PPPoE correspondante.

**5.** Un terminal mobile, ci-après appelé MT, pour connecter, sur un réseau local, ci-après appelé LAN, une pluralité d'appareils, chacun ayant une adresse IP unique, à travers un lien sans fil unique à un réseau de données par paquets, ci-après appelé PDN, ledit MT étant **caractérisé en ce qu'**il comprend :

- une pile protocole point à point, ci-après appelée pile PPP, pour connecter le MT à la pluralité d'appareils en utilisant une session protocole point à point Ethernet, ci-après appelée session PPPoE, différente pour chacun desdits appareils; et
- une pluralité de contextes PDP IP distincts, chaque contexte PDP étant lié à un appareil de la pluralité d'appareils, où chaque contexte PDP comprend une adresse IP individuelle unique pour un des appareils.

**6.** Le terminal mobile selon la revendication 5, dans lequel le MT comprend des moyens pour demander les contextes PDP distincts du PDN et dans lequel la pile PPP comprend:

- des moyens pour connecter le MT à la pluralité d'appareils sur le LAN;
- des moyens pour recevoir une indication de chaque appareil individuel sur le LAN si l'appareil requière une adresse IP; et
- des moyens pour distribuer des adresses IP à la pluralité d'appareils sur le LAN.

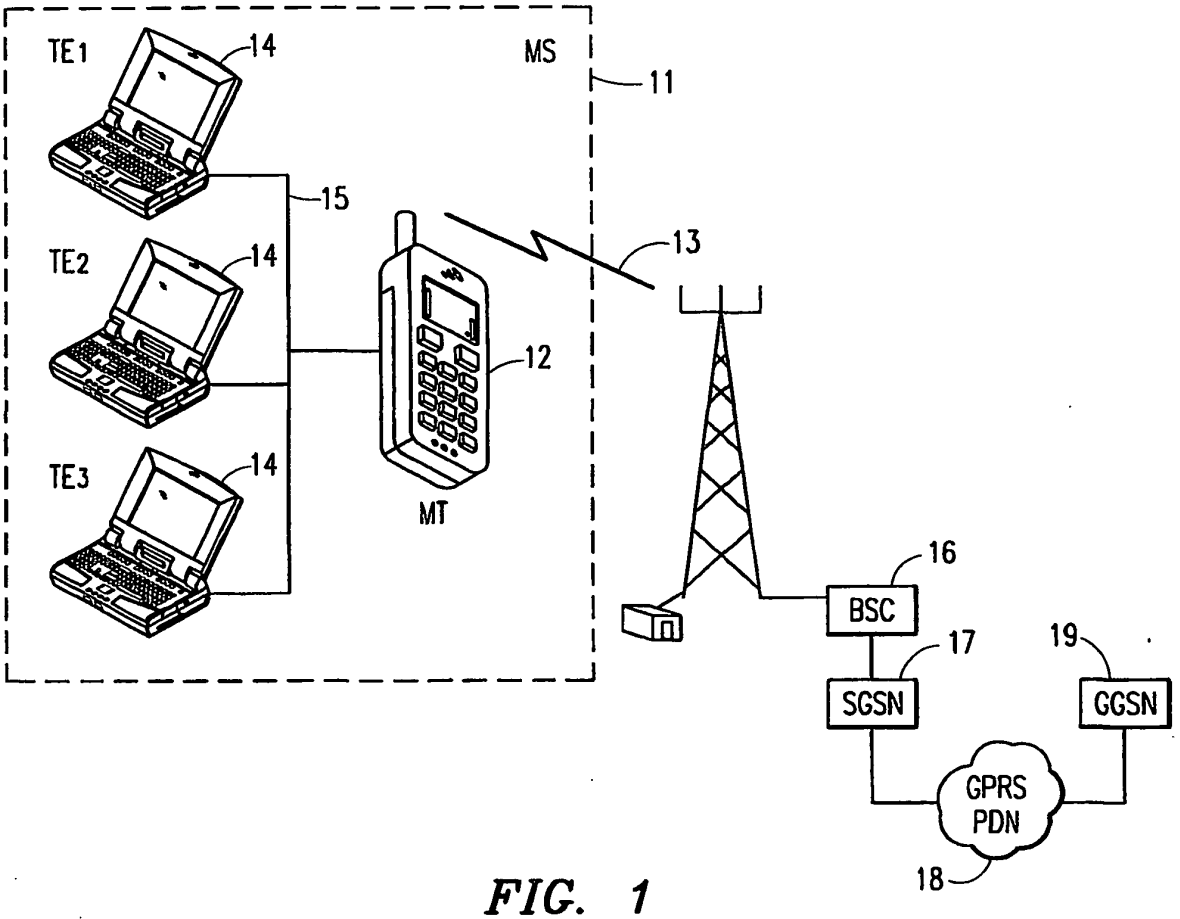
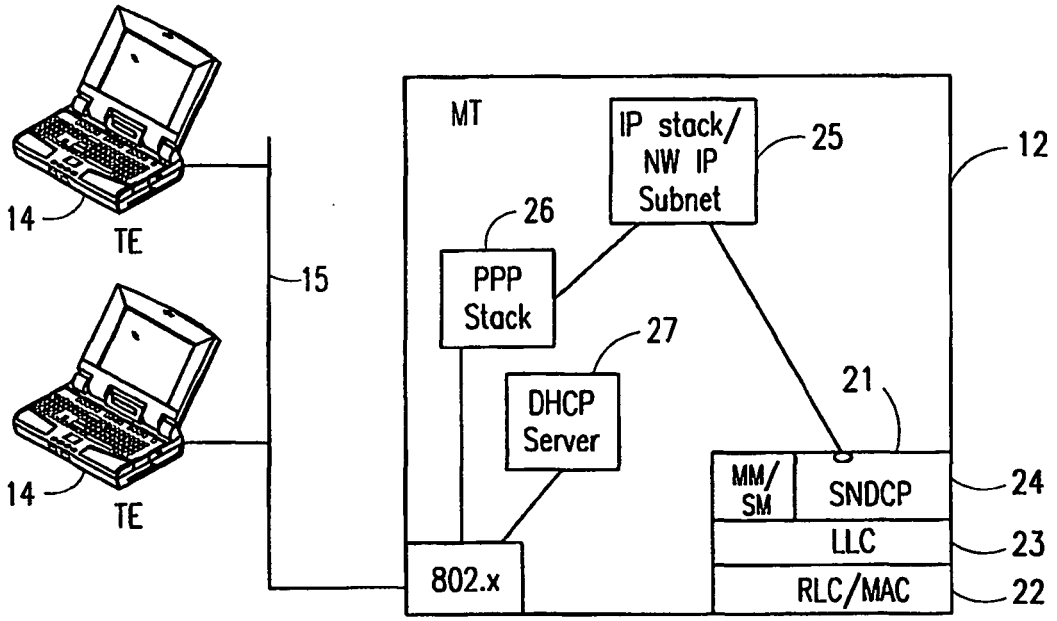

TE1
14
MS
11
15
TE2
14
13
12
TE3
14
MT
16
BSC
17
19
SGSN
GGSN
GPRS
PDN
18

*FIG. 1*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IP stack/
NW IP
Subnet
25
12
26
PPP
Stack
27
DHCP
Server
21
MM/
SM
SNDCP
24
LLC
23
RLC/MAC
22
802.x
15
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TE
14
TE

*FIG. 2*

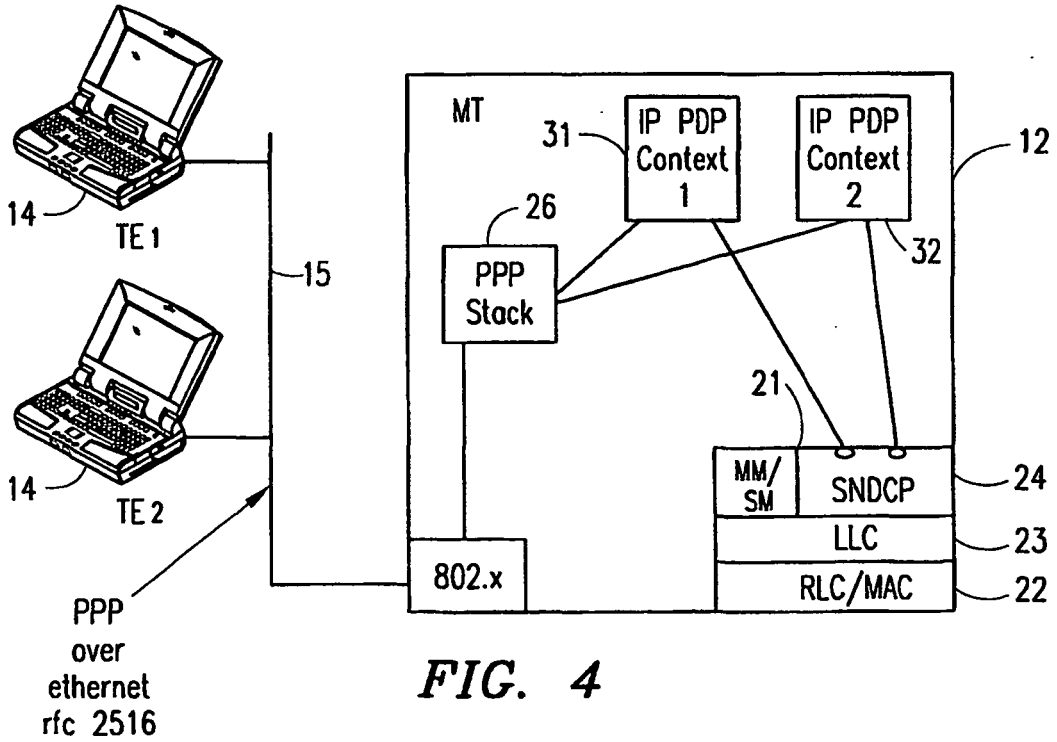
MT
31
IP PDP
Context
1
IP PDP
Context
2
12
26
32
PPP
Stack
21
MM/
SM
SNDCP
24
LLC
23
RLC/MAC
22
802.x
15
14
TE 1
14
TE 2
PPP
over
ethernet
rfc 2516

*FIG. 4*

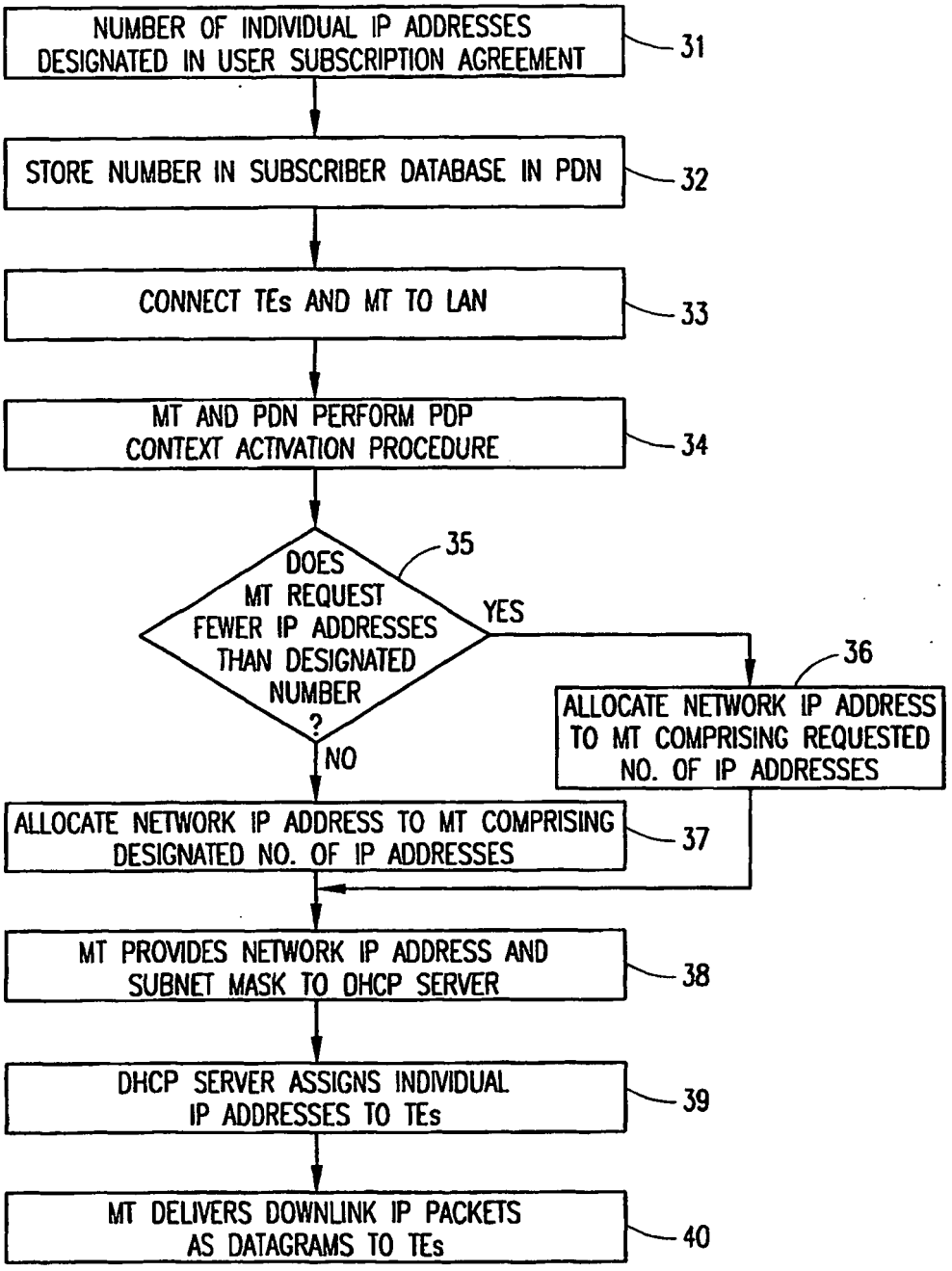
NUMBER OF INDIVIDUAL IP ADDRESSES DESIGNATED IN USER SUBSCRIPTION AGREEMENT
31
STORE NUMBER IN SUBSCRIBER DATABASE IN PDN
32
CONNECT TEs AND MT TO LAN
33
MT AND PDN PERFORM PDP CONTEXT ACTIVATION PROCEDURE
34
DOES MT REQUEST FEWER IP ADDRESSES THAN DESIGNATED NUMBER ?
35
YES
NO
ALLOCATE NETWORK IP ADDRESS TO MT COMPRISING REQUESTED NO. OF IP ADDRESSES
36
ALLOCATE NETWORK IP ADDRESS TO MT COMPRISING DESIGNATED NO. OF IP ADDRESSES
37
MT PROVIDES NETWORK IP ADDRESS AND SUBNET MASK TO DHCP SERVER
38
DHCP SERVER ASSIGNS INDIVIDUAL IP ADDRESSES TO TEs
39
MT DELIVERS DOWNLINK IP PACKETS AS DATAGRAMS TO TEs
40

*FIG. 3*

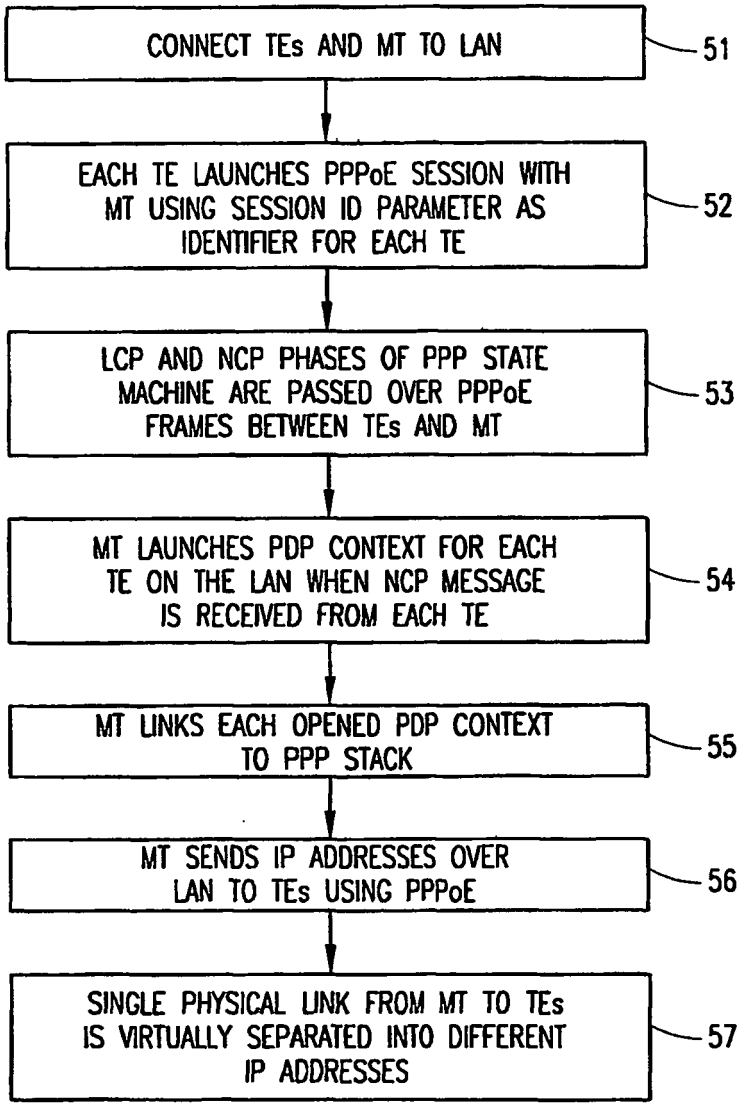
CONNECT TEs AND MT TO LAN
51
EACH TE LAUNCHES PPPoE SESSION WITH MT USING SESSION ID PARAMETER AS IDENTIFIER FOR EACH TE
52
LCP AND NCP PHASES OF PPP STATE MACHINE ARE PASSED OVER PPPoE FRAMES BETWEEN TEs AND MT
53
MT LAUNCHES PDP CONTEXT FOR EACH TE ON THE LAN WHEN NCP MESSAGE IS RECEIVED FROM EACH TE
54
MT LINKS EACH OPENED PDP CONTEXT TO PPP STACK
55
MT SENDS IP ADDRESSES OVER LAN TO TEs USING PPPoE
56
SINGLE PHYSICAL LINK FROM MT TO TEs IS VIRTUALLY SEPARATED INTO DIFFERENT IP ADDRESSES
57

*FIG. 5*